SEQUENCE OF OPERATION (TYP. FOR AHU-1,2):

A. GENERAL: THE SYSTEM SHALL BE CONTROLLED BY A STAND-ALONE CONTROL SYSTEM. WITH THE H-O-A SWITCH IN THE "AUTO" POSITION, THE SYSTEM SHALL START THROUGH THE BAS SYSTEM AND OPERATE AS DESCRIBED BELOW, PROVIDED THE SAFETIES HAVE BEEN SATISFIED.

B. DISABLED MODE - WHEN THE AHU IS IN THE DISABLED MODE:
1. THE SUPPLY FAN SHALL BE DE-ENERGIZED.
2. THE OUTSIDE AIR DAMPER SHALL BE CLOSED AND THE RETURN AIR DAMPER SHALL BE OPEN.
3. THE SMOKE DAMPERS ASSOCIATED WITH THE UNIT SHALL BE CLOSED.
4. THE CHILLED WATER COIL VALVE SHALL BE CLOSED TO THE COIL.
5. THE FREEZE PROTECTION PUMP SHALL BE ENERGIZED IF THE OUTSIDE AIR TEMPERATURE IS BELOW 35F (ADJ.)

C. UNOCCUPIED PERIOD OPERATING MODE:
1. THE UNIT SHALL OPERATE DURING THE UNOCCUPIED PERIOD UNDER THE FOLLOWING CONDITIONS:
   A. THE TEMPERATURE AT ANY SPACE SENSOR IS BELOW THE UNOCCUPIED PERIOD HEATING SETPOINT.
   B. THE TEMPERATURE AT ANY SPACE SENSOR IS ABOVE THE UNOCCUPIED PERIOD COOLING SETPOINT.
   C. AN UNOCCUPIED PERIOD OVERRIDE BUTTON IS PUSHED AT ANY SPACE SENSOR.
2. WHILE IN THE UNOCCUPIED PERIOD OPERATING MODE, THE DISCHARGE AIR TEMPERATURE SHALL BE AS SPECIFIED BELOW FOR THE NORMAL OPERATING MODE.
3. DURING THE UNOCCUPIED PERIOD OPERATING MODE, THE TERMINAL UNITS SHALL OPERATE AS SPECIFIED BELOW FOR THE NORMAL OPERATING MODE

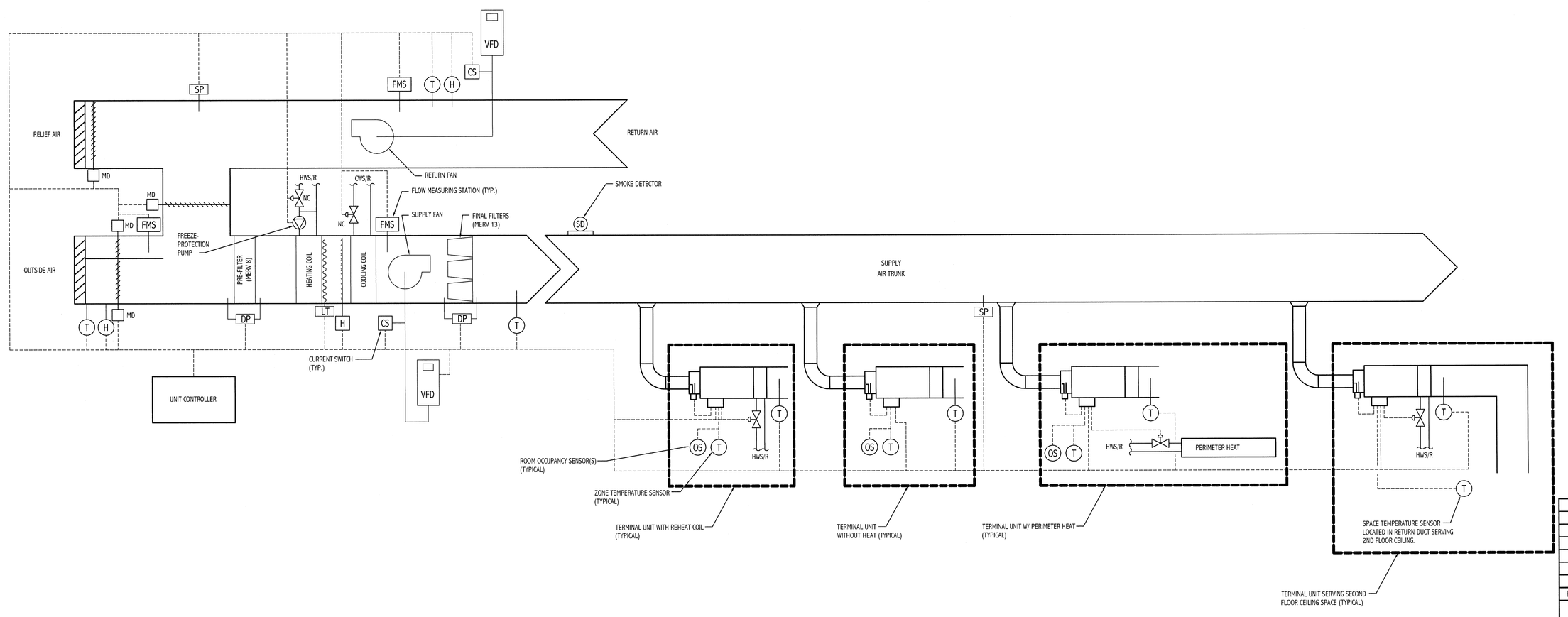
D. START-UP MODE (MORNING WARM-UP/PULL-DOWN):
1. THE START-UP MODE SHALL BE OPTIMIZED BY THE BUILDING MANAGEMENT SYSTEM TO ADJUST THE START TIME TO THE BUILDING RESPONSE TIME.
2.DURING THE START-UP MODE, THE OUTSIDE AIR DAMPER SHALL BE FULLY CLOSED.

E. EMERGENCY POWER START-UP MODE:
1. IF POWER IS INTERRUPTED, THE UNIT FANS SHALL RAMP BACK TO NORMAL SPEED AT A RATE NOT GREATER THAN 5 HZ PER MINUTE.

F. NORMAL OPERATING MODE:
1. THE UNIT SHALL GO INTO NORMAL OPERATING MODE WHEN THE BUILDING ENTERS THE OCCUPIED PERIOD.
2. THE SMOKE DAMPERS ASSOCIATED WITH THE UNIT SHALL OPEN FULLY.
3. THE MINIMUM OUTSIDE AIR DAMPER SHALL OPEN FULLY.
4. ONCE THE SMOKE DAMPERS AND MINIMUM OUTSIDE AIR DAMPER ARE PROVEN OPEN, THE SUPPLY FAN SHALL BE ENABLED. THE RETURN FAN SHALL BE INTERLOCKED WITH THE SUPPLY FAN SO THAT THE SUPPLY FAN AND RETURN FAN MUST OPERATE SIMULTANEOUSLY.
5. SUPPLY FAN CONTROL:
   a. THE SUPPLY FAN SHALL OPERATE CONTINUOUSLY DURING THE OCCUPIED PERIOD.
   b. A SUPPLY FAN VFD SHALL MODULATE THE FAN SPEED AS NECESSARY TO MAINTAIN ALL TERMINAL UNIT DAMPERS AT 90% OF FULL OPEN, OR LESS.
   c. IF ONE OR MORE TERMINAL UNIT DAMPERS IS OPEN MORE THAN 90%, THE SUPPLY FAN VFD SHALL LOWER THE FAN SPEED AT A RATE NO GREATER THAN 1 HZ PER MINUTE (ADJ.).
   d. A DUCT STATIC PRESSURE SENSOR SHALL BE INSTALLED ALTHOUGH NOT CURRENTLY USED IN THE SEQUENCE.
6. RETURN FAN CONTROL:
   a. THE RETURN FAN SHALL BE INTERLOCKED WITH THE SUPPLY FAN.
   b. A RETURN FAN VFD SHALL MODULATE THE RETURN FAN SPEED TO MAINTAIN STATIC PRESSURE IN THE MIXING BOX PLENUM AT -0.02" W.C.
7. DAMPER CONTROL:
   a. THE MINIMUM OUTSIDE AIR DAMPER SHALL OPEN FULLY AND THE RETURN DAMPER SHALL MODULATE TO MAINTAIN A CONSTANT DIFFERENTIAL PRESSURE (DP) ACROSS THE OUTSIDE AIR DAMPER DAMPER. THE TAB CONTRACTOR SHALL DETERMINE THE DP ACROSS THE MINIMUM OUTSIDE AIR DAMPER DURING MINIMUM OUTSIDE AIRFLOW
   b. IN SPACES THAT CONTAIN CO2 SENSORS, THE VAV BOX DAMPER MINIMUM SHALL BE RESET TOWARDS 100% COOLING TO MAINTAIN SPACE CO2 LEVEL AT 1,000 PPM. IF THE SPACE CO2 LEVEL CONTINUES TO RISE, THE MINIMUM OSA SETPOINT AT THE AHU SHALL BE RESET UPWARDS. CO2 SENSORS SHALL BE INSTALLED IN THE FOLLOWING ROOMS:
      1) CONFERENCE ROOM 3311
      2) CONFERENCE ROOM 3312
      3) CONFERENCE ROOM 3313
      4) WAITING 3272
      5) WAITING 3224
      6) WAITING 3199
      7) BREAK ROOM 3151
      8) WAITING 3017
      9) WAITING 3138
      10) WAITING 3114
      11) WAITING 3064
   c. ECONOMIZER DAMPER CONTROL - IF THE OSA ENTHALPY IS LESS THAN THE RA ENTHALPY, THE OSA DAMPER AND RETURN AIR DAMPER SHALL SHALL BE MODULATED TO MAINTAIN DISCHARGE AIR TEMPERATURE AT SETPOINT. IF THE OSA ENTHALPY IS LESS THAN THE RA ENTHALPY, THE OSA DAMPER IS 100% OPEN AND THE DISCHARGE AIR TEMPERATURE IS ABOVE SETPOINT, THEN MECHANICAL COOLING SHALL BE ENABLED AS DESCRIBED BELOW TO MAINTAIN SETPOINT. IF OSA ENTHALPY IS GREATER THAN THE RA ENTHALPY, THEN MECHANICAL COOLING SHALL BE ENABLED TO MAINTAIN SETPOINT.
   d. RELIEF DAMPER CONTROL - MODULATE THE RELIEF DAMPER TO MAINTAIN THE BUILDING DIFFERENTIAL PRESSURE (DP) AT SETPOINT. THE BUILDING DP SHALL BE DETERMINED BY CALCULATING A RUNNING AVERAGE OF THE PAST 15 MINUTES OF DP READINGS. ONE READING SHALL BE TAKEN PER 5 SECONDS. THE SYSTEM DP SENSOR SHALL BE PLACED AS INDICATED ON THE DRAWINGS.
   e. THE MINIMUM OUTSIDE AIR AND ECONOMIZER DAMPERS SHALL FAIL CLOSED. THE RELIEF DAMPER SHALL FAIL CLOSED. THE RETURN DAMPER SHALL FAIL OPEN.
8. DISCHARGE AIR TEMPERATURE CONTROL:
   a. THE DISCHARGE AIR TEMPERATURE SHALL BE MAINTAINED AT 53F WHEN THE OUTSIDE AIR TEMPERATURE IS 70F OR ABOVE.
   b. THE DISCHARGE AIR TEMPERATURE SHALL BE RESET UPWARDS FROM 53F AT 70F OSA TEMPERATURE TO 65F AT 40F OSA TEMPERATURE.
   c. BELOW 40F OSA TEMPERATURE, THE DISCHARGE TEMPERATURE SHALL BE 65F.
   d. IF THERE IS A CALL FOR COOLING, AND THE SYSTEM IS IN ECONOMIZER MODE, THE OUTSIDE AIR DAMPER AND THE RETURN AIR DAMPER SHALL MODULATE TO MAINTAIN DISCHARGE AIR TEMPERATURE AT SETPOINT.
   e. IF THERE IS A CALL FOR COOLING AND THE SYSTEM IS NOT IN ECONOMIZER MODE, THE COOLING COIL CONTROL VALVE SHALL MODULATE TO MAINTAIN DISCHARGE TEMPERATURE AT SETPOINT.
   f. IF EITHER THE OUTSIDE AIR TEMPERATURE IS 40F OR BELOW, OR THERE IS A CALL FOR HEATING, THE HEATING COIL FREEZE PROTECTION PUMP SHALL BE ENABLED. IF A HEAT RECOVERY COIL IS PRESENT, THE HEAT RECOVERY COIL VALVE SHALL BE MODULATED TO MAINTAIN DISCHARGE AIR TEMPERATURE. IF THE HEAT RECOVERY COIL VALVE IS FULLY OPEN TO THE HEAT RECOVERY COIL AND THE DISCHARGE AIR TEMPERATURE IS STILL LESS THAN SETPOINT, THE HEATING COIL CONTROL VALVE SHALL BE MODULATED TO MAINTAIN DISCHARGE AIR TEMPERATURE AT SETPOINT.
9. HUMIDIFIER CONTROL
   a. THE HUMIDIFIERS SHALL BE CONTROLLED BY THE PACKAGED HUMIDIFIER CONTROLS TO MAINTAIN 35% RH AS MEASURED IN THE RETURN DUCT.
   b. A SEPARATE HUMIDITY SENSOR SHALL CONNECT TO THE DDC SYSTEM TO MONITOR RETURN DUCT HUMIDITY LEVEL AT THE USER WORKSTATION.
   c. THE PACKAGED HUMIDIFIER CONTROLS SHALL PROVIDE A HIGH LIMIT SWITCH, AIRFLOW PROVING SWITCH, AND VAV COMPENSATING CONTROLS.

G. SAFETY DEVICES:
1. THE UNIT SHALL GO INTO DISABLED MODE IF SMOKE IS DETECTED AT THE SMOKE DETECTOR LOCATED IN THE RETURN DUCT.
2. IF THE RETURN WATER TEMPERATURE FROM THE HEATING COIL DROPS TO 80F, THE OUTSIDE AIR DAMPER SHALL BE CLOSED FULLY AND AN ALARM SHALL BE LOGGED AT THE DDC USER WORKSTATION.
3. IF THE FREEZESTAT SERPENTINED ACROSS THE HEATING COIL FACE SENSES A TEMPERATURE BELOW AT 36F (OR AS SET), THE UNIT SHALL GO INTO DISABLED MODE AND ALARM SHALL BE INITIATED.
4. IF THE DISCHARGE AIR TEMPERATURE DROPS BELOW SETPOINT BY 2 DEGREES FOR 5 MINUTES AND THE HEATING COIL VALVE IS FULLY OPEN, THE OSA ECONOMIZER DAMPER SHALL BE FULLY CLOSED, AND THE MINIMUM OSA DAMPER SHALL BE SLOWLY MODULATED TOWARDS CLOSED TO PREVENT THE UNIT FROM GOING INTO DISABLED MODE. A LOW OSA FLOW ALARM SHALL BE INITIATED.
5. AN ALARM SHALL BE ACTIVATED ANYTIME THE AIR HANDLER UNIT IS COMMANDED "ON" AND EITHER THE SUPPLY FAN OR RETURN FAN FAILS TO OPERATE.
6. FILTER MONITORING: THE PREFILTERS SHALL BE CHANGED OUT AT 0.5"W.C. AN ALARM SHALL BE LOGGED AT THE USER WORKSTATION WHEN THE DP ACROSS THE PREFILTERS REACHES THIS SETPOINT. THE FINAL FILTERS SHALL BE CHANGED OUT AT 1.0"W.C. AN ALARM SHALL BE LOGGED AT THE USER WORKSTATION WHEN THE DP ACROSS THE FINAL FILTERS REACHES THIS SETPOINT.
7. FAN SAFETIES:
   a. THE UNIT SHALL GO INTO DISABLED MODE AND AN ALARM SHALL BE INITIATED IF A STATIC PRESSURE OF 6" IS MEASURED DOWNSTREAM OF THE FINAL FILTERS.
   b. THE UNIT SHALL GO INTO DISABLED MODE AND AN ALARM SHALL BE INITIATED IF A NEGATIVE STATIC PRESSURE OF 2.5" IS MEASURED AT THE INLET OF THE RETURN FAN.
   c. INITIATE AN ALARM IF SUPPLY FAN IS ENABLED AND OPERATION IS NOT PROVEN BY A CURRENT SWITCH AFTER 2 MINUTES.
   d. INITIATE AN ALARM IF SUPPLY FAN IS ENABLED AND RETURN FAN OPERATION IS NOT PROVEN BY A CURRENT SWITCH AFTER 2 MINUTES.
8. INITIATE AN ALARM IF DISCHARGE AIR TEMPERATURE DEVIATES FROM SETPOINT BY 4 DEGREES FOR 5 MINUTES.

H. THE FOLLOWING POINTS SHALL BE AVAILABLE FOR MONITORING AT THE USER WORKSTATION:
1. OUTSIDE AIR TEMPERATURE.
2. MIXED AIR TEMPERATURE.
3. DISCHARGE AIR TEMPERATURE.
4. SUPPLY AIRFLOW.
5. RETURN AIRFLOW.
6. MINIMUM OUTSIDE AIRFLOW.
7. RETURN AIR HUMIDITY LEVEL.
8. SUPPLY FAN SPEED IN HZ.
9. RETURN FAN SPEED IN HZ.
10. SUPPLY FAN STATUS.
11. RETURN FAN STATUS
12. FREEZE-PROTECTION PUMP STATUS
13. PRE-FILTER PRESSURE DROP
14. FINAL FILTER PRESSURE DROP



ZONE SEQUENCE OF OPERATION

A. VAV CONTROL: MODULATE THE VARIABLE AIR VOLUME DAMPER TO MAINTAIN ZONE TEMPERATURE AT SETPOINT. ON A RISE OF TEMPERATURE ABOVE THE COOLING SET POINT, THE VAV TERMINAL UNIT DAMPER SHALL MODULATE OPEN. AS THE TEMPERATURE DROPS BELOW THE SPACE SET POINT, THE TERMINAL UNIT SHALL MODULATE TOWARDS ITS MINIMUM CFM. AS THE SPACE TEMPERATURE CONTINUES TO FALL TO THE HEATING SET POINT, THE PROPORTIONAL HOT WATER VALVE SHALL MODULATE OPEN. IF THE ZONE CONTAINS RADIANT HEAT, THE RADIANT HEATING ZONE VALVE SHALL MODULATE OPEN IN PARALLEL WITH THE REHEAT COIL.

B. PROVIDE NIGHT SETBACK AND MORNING WARM-UP AS REQUIRED BY THE ASSOCIATED SYSTEM.

C. IF DURING THE OCCUPIED PERIOD THE ZONE OCCUPANCY SENSORS ALL DETERMINE THAT THE ROOM IS UNOCCUPIED, THE BOX SHALL MODULATE TO MINIMUM POSITION. IF ANY ONE OF THE OCCUPANCY SENSORS SHOWS THAT THE SPACE IS OCCUPIED, THE TERMINAL BOX SHALL OPERATE AS NORMAL.

D. VAV CONTROL WITH DEMAND VENTILATION: SEQUENCE FOR HEATING, COOLING AND SETBACK SHALL BE AS DESCRIBED ABOVE. HOWEVER, UPON AN INCREASE IN CO2 THE VARIABLE AIR VOLUME DAMPER SHALL MODULATE OPEN TO ITS MAXIMUM CFM TO MAINTAIN CO2 BELOW 1000 PPM. IF THE CO2 CONTINUES TO INCREASE ABOVE THE 1000 PPM THEN THE OUTSIDE AIR DAMPER AT THE AIR HANDLER SHALL MODULATE OPEN TO PROVIDE MORE OUTSIDE AIR. THE REHEAT COIL SHALL PROVIDE REHEAT TO CONTROL SPACE TEMPERATURE.

E. PROVIDE A TEMPERATURE SENSOR LOCATED IN THE DISCHARGE OF EACH TERMINAL BOX TO MONITOR THE DISCHARGE AIR TEMPERATURE AT THE BOX OUTLET. THIS POINT SHALL BE MONITORED AT THE USER WORKSTATION.

PLANT-WIDE CONTROLLER SEQUENCE OF OPERATION

A. REFERENCE SECTION 235216 - CONDENSING BOILERS FOR THE PLANT-WIDE CONTROLLER SEQUENCE OF OPERATION. THE PWC SYSTEM SHALL BE STAND-ALONE CONTROLS WITH A SET OF DRY CONTACTS FOR A GENERAL ALARM POINT. THE DDC CONTROL CONTRACTOR SHALL CONNECT TO THE DRY ALARM CONTACTS TO INITIATE AN ALARM AT THE DDC WORKSTATION ON A GENERAL ALARM.

GLYCOL FEED SYSTEM SEQUENCE OF OPERATION

A. THE GLYCOL FEED SYSTEM SHALL OPERATE WITH STAND-ALONE CONTROLS.

B. ALARM POINTS - INITIATE AN ALARM AT THE DDC WORKSTATION IF:
1) THE GENERAL ALARM CONTACTS CLOSE.

DOMESTIC HOT WATER SYSTEM SEQUENCE OF OPERATION

A. THE DOMESTIC WATER HEATER BOILER WATER VALVE SHALL BE MODULATED TO MAINTAIN TANK TEMPERATURE AT SETPOINT (140F TO PREVENT LEGIONELLA).

B. THE TANK RECIRCULATION PUMP SHALL BE ENERGIZED AS REQUIRED BY THE WATER HEATER MANUFACTURER.

C. HOT WATER RECIRC PUMP (RP-1) SHALL BE ENERGIZED DURING THE BUILDING OCCUPIED PERIOD AND DE-ENERGIZED DURING THE BUILDING UNOCCUPIED PERIOD.

D. ALARM POINTS - INITIATE AN ALARM AT THE DDC WORKSTATION IF:
1) THE DOMESTIC WATER STORAGE TEMPERATURE EITHER DROPS BELOW 135 OR RISES ABOVE 145F.

E. MONITORING POINTS
1) DOMESTIC WATER STORAGE TEMPERATURE

GENERAL EXHAUST FAN (EF-1, EF-2) SEQUENCE OF OPERATION

A. THE EXHAUST FAN (EF-1, EF-2) SHALL BE ENERGIZED WHENEVER THE BUILDING IS IN OCCUPIED MODE.

B. ALARM POINTS - INITIATE AN ALARM AT THE DDC WORKSTATION IF:
1) EF-1 IS ENABLED AND FAILS TO ENERGIZE.
2) EF-2 IS ENABLED AND FAILS TO ENERGIZE.

C. MONITORING POINTS
1) EF-1 FAN STATUS
2) EF-2 FAN STATUS.

GENERAL EXHAUST FAN (EF-3) SEQUENCE OF OPERATION

A. THE EXHAUST DAMPER AND OUTSIDE AIR DAMPER SHALL BE OPENED ON A CALL FOR COOLING BY THE PENTHOUSE TEMPERATURE SENSOR.

B. THE EXHAUST FAN (EF-3) SHALL BE ENERGIZED WHEN THE EXHAUST DAMPER AND OUTSIDE AIR DAMPER ARE PROVEN OPEN.

B. ALARM POINTS - INITIATE AN ALARM AT THE DDC WORKSTATION IF:
1) EF-3 IS ENABLED AND FAILS TO ENERGIZE.
2) THE PENTHOUSE TEMPERATURE RISES ABOVE 100F (ADJ).

C. MONITORING POINTS
1) EF-3 FAN STATUS.
2) PENTHOUSE TEMPERATURE.

MISCELLANEOUS PLUMBING PUMPS SEQUENCE OF OPERATION

A. THE ELEVATOR SUMP PUMP (WP-1) SHALL BE OPERATED BY THE LEVEL CONTROLS PROVIDED WITH EACH PUMP.

D. ALARM POINTS - INITIATE AN ALARM AT THE DDC WORKSTATION IF:
1) THE DRY CONTACTS ON THE ELEVATOR SUMP PUMP (WP-1) CONTROL PANEL INDICATE A GENERAL ALARM.

NOTE:
1. SEE G001 FOR PROJECT GENERAL NOTES
2. SEE SHEET M-001 FOR LEGEND AND ABBREVIATIONS.

REV.	DESCRIPTION	DATE

ISSUED FOR G.M.P. & PERMITTING
4-3-09
CURRENT ISSUE STATUS:

SMRT
ARCHITECTURE
ENGINEERING
PLANNING
INTERIOR DESIGN
COMMISSIONING
144 Fore Street,P.O. Box 618
Portland, Maine 04104
tel. (207) 772-3846
fax. (207) 772-1070
www.smrtinc.com

MARTIN'S POINT HEALTH CARE
MEDICAL OFFICE BUILDING
PORTLAND, MAINE

MECHANICAL SCHEMATICS
SHEET TITLE:

SCALE:	AS NOTED	DATE:	
PROJECT MANAGER:	SLB	GRAPHIC SCALE:	0" 1"
JOB CAP/DRAWN:	TCM/DJL		
A/E OF RECORD:	TAC	SHEET No.	
SMRT CAD FILE:	M-653-08139		M-653
PROJECT No.	08139		

©copyright 2009 SMRT

PROGRESS PRINT

A1	AIR HANDLING SYSTEM SCHEMATIC
NOT TO SCALE	